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Teaching Remedial Courses: Challenges and Teaching Philosophy

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Abstract

Students entering the university come from different backgrounds and have different problems. There are those who have never been taught how to face challenges; those who only know how to follow algorithms or even *formulas* to solve problems, never questioning why this method or algorithm works; those who do not know how to study or how to be more efficient; those who completely depend on the help of tutoring services; those who are completely unable to do any math work without the aid of a calculator; and those who simply lack self-confidence. In my presentation, I highlight some of these problems with possible solutions to deal with and give an overview of the principals of my teaching philosophy.

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1. Introduction

Remedial or preparatory courses in mathematics aim principally at improving the performance of students who are under-prepared for university-level courses. However, very often these students have problems and disabilities that go beyond the subject matter itself. Indeed, any instructor teaching a remedial math course will agree that the most common challenges faced in the classroom are related to the lack of conceptual understanding of mathematical principles, the consequences of the early calculator use, and the negative effects of private tutoring services on a student's self-confidence. These three problems need to be taken seriously by teachers and educators. The present paper contributes to this issue by offering a brief discussion of how these problems can affect the learning process and by giving a brief description of my teaching philosophy of a remedial math course.

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2. Challenges facing the remedial math instructors

2.1 Lack of conceptual understanding of mathematical principles

A significant number of students taking math courses have not developed a deep conceptual understanding of mathematics. They are unable to tell why a particular solution is the right one, as they only know how to follow algorithms or formulas to solve the problems. They never question why that particular method or algorithm works. In order to illustrate this problem, we can consider two simple examples, describing how these students would solve them. The first example is about solving linear equations, and the second one is about factoring quadratic expressions.

Example 1:

Solve for x the equation $x + 2 = 9$. This equation is very simple, and 99% of students will get it right. To solve it they would say:

"We move 2 to the other side of the equation, and we change the sign. We get $x = 9 - 2$, and so $x = 7$."
The answer is perfectly correct. But, how can we make them realize that even though this solution is correct, it is not mathematically rigorous because the word "move" is not accurate?

If I ask them to solve the inequality $x + 2 < 9$, they will use the same reasoning; "We move 2 to the other side of the equation, and we change the sign." Again, they get the right answer: $x < 7$.

If I ask them to solve the double inequality $4 < x + 2 < 9$, they will say again without hesitation, "We move 2 to the other side, and we change the sign." When I ask them if they will move the 2 to the right side or the left side, I can clearly see their confusion. After a few minutes of hesitation, I get different answers; some of them will respond that they would move it to the right, while others will say that they would move it to the left, or that they do not know. With this example, I make them realize that we do not in fact move anything. Instead, we use the addition and multiplications rules of the equations and inequalities to solve the problem. What amazes me is that most of the students have never heard of these rules.

Let us now look at factoring the quadratic expression $ax^2 + bx + c$. As you know, we can use the *ac method* for the factorization of quadratic polynomials. However, when I mention this method, students will say that they use the sum and product method instead. Of course, this is the same thing, but they do not know that. For this second problem, we consider two examples: one with $a = 1$ and the other with $a \neq 1$.

Example 2:

To solve the quadratic expression $x^2 - 5x + 4$ (here, $a = 1$), the students will search for two numbers with a sum equal to -5 and a product equal to 4. Many of them will get the correct answer. When factorizing the quadratic expression $2x^2 - 7x + 5$ (here, $a \neq 1$), the majority of students will try to find two numbers with a sum equal to -7 and a product equal to 5. In doing so, they will completely ignore the coefficient of x^2 and will not see any problem with that. Again, they have learned an algorithm that does not work all the time.

2.2 The consequences of the early use of the calculator

A calculator, like any other technological tool, can play an important and helpful role in the mathematical learning process, for example, by saving students' time when computing long and tiring calculations. Nevertheless, the early use of the calculator (at a young age) can prevent students from effectively learning mathematical principles and understanding basic concepts. Many students develop a real dependency on the calculator, and they are unable to do even the simplest mathematical work without it. They use their calculators for multiplication as simple as 3 times 1. We often assume that the student using the calculator is able to, at the very least, verify that the answer obtained makes sense; unfortunately, this is not always the case. Many times, I have seen examples of calculation mistakes that do not make any sense, but that the student accepts without any problem. If I ask the student how the answer can be correct, he or she will say: "The calculator gave it to me, so it must be right." This

passivity and lack of analysis is a direct consequence of the intellectual laziness that develops when students rely on calculators from a very young age.

2.3 The effects of the private tutoring on the self-confidence

Nowadays, math tutoring services play an important role for many families. Indeed, the use of these services is not just for young kids, but also often for students taking remedial courses who continue to need a tutor for their studies. Certainly, private tutoring has a positive side. But, its negative side is the creation of dependence. I have noticed in my classes that students who have tutors at home do not see the need to listen in class and are unable to find solutions to the problems by themselves. I have also noticed that when solving problems, if they cannot find the solution on their first try, they give up quickly. Instead, they wait for someone else to give them a *hint* or to do the work for them. This is because they have never been taught how to read a math problem and how to find the information required to solve it. Someone else has always *simplified their life* by giving them the required key ideas. In other words these students are completely dependent on the help of a tutor for the majority of their math work. Consequently, they lose all confidence in themselves and in their capabilities. Sadly, they end up convincing themselves that they are not good at math and never will be. When such a thing happens, it is imperative that the educator make use of all of his or her skills as a psychologist in order to help the student to rebuild this self-confidence, because self-confidence is one of the most important pillars in the process of learning mathematics.

After revealing above three of the major challenges faced by an instructor, the question now is what can be done to fix or at least to reduce these issues?

Firstly, I do not want to place the blame on high school math teachers, but I sincerely believe that teachers should focus more on developing a conceptual understanding of mathematics among students. They should explain to students why and how things work, rather than just teaching them to follow formulas without really understanding what they are doing. Secondly, I believe that we should restrict the use of the calculator in primary and secondary schools so that students have time to assimilate basic mathematical principles. Finally, tutors must be chosen carefully. We must choose tutors who will never think for students or do the work for them. Instead, tutors should show students how to read the problems, how to find the key ideas, and, most importantly, how to be confident about their own abilities.

3. Overview of my Teaching Philosophy

The second part of this paper consists of an overview of my teaching philosophy and a description of the methodology used in my classroom.

Of course, over time, all instructors develop a method of teaching that is unique to them and that suits their students. However, I believe that there are four things that a good math teacher must have: 1) a passion and motivation for the profession, 2) competency and professionalism, 3) the ability to give individual attention and be available to the students, and 4) the ability to establish high standards in the classroom.

3.1 Passion and motivation for the profession

As with any profession, the first thing that a math teacher must have is a love for the job, because when you like what you do, you do it in the best way possible; motivation is never an issue.

3.2 Competency and professionalism

Competency and professionalism in teaching mathematics is demonstrated in the ways in which the teacher manages the classroom and presents the material. In my experience, I have learned that being competent and professional means:

- Being prepared for every lecture

We should always make sure that the course is well prepared before we enter the classroom. The key to

preparation is not in the material itself, since that is already known, but rather in finding which methodology would be suitable for a particular classroom.

- Explaining things in a clear and simple manner

There are many ways to present the material. A successful approach is to break down the material into small pieces with the help of examples, taking students step-by-step through the topic at hand. The goal should be to solve an example that brings everything together.

- Giving examples and relevant applications for students to understand the material

The illustration of mathematical concepts through examples and well-crafted, real-life applications can show students clear connections between mathematics and their daily lives. As a result, students will realize that math is everywhere, all around them, which can make them more motivated and interested in the topic.

- Always highlighting students' common mistakes

My experience in teaching remedial mathematics courses has enabled me to learn almost 95% of students' common mistakes. Therefore, when explaining a theory, I always point out mistakes that students tend to make, explaining why the solutions are wrong and how the same mistakes can be avoided.

- Taking advantage of technology as much as possible

Today, technology is everywhere and essential to many aspects of our daily lives. I take advantage of this technology and use it as much as I can in my teaching. As example I use MyMathLab to provide my students with more practice problems to improve their learning skills. And to illustrate many important mathematical concepts in calculus, such as Newton's method and Riemann sum I use the softwares Mathematica and Maple.

- Guiding students in their learning process

The vast majority of students taking remedial courses still need to be guided and helped in keeping their learning skills on track. A caring instructor usually helps his or her students in this matter by providing them with an exhaustive and comprehensive list of exercises to practice, along with clear and concise handouts and summaries designed to reinforce their performance. The instructor can also help students to develop regular study skills by assigning graded homework and quizzes on regular basis.

- Creating an atmosphere favoring student enthusiasm

No matter how structured and clear your teaching is, you have to create a good atmosphere that can maintain the attention of the students and motivate them. It is also critical to establish respect between the instructor and the students.

- Involving students in classroom life

Getting students motivated and involved in the active life of the classroom is one of the most important parts of the learning process and one that is often very challenging for the instructor. In my classes, no student is left behind and all of them must participate in suggesting solutions.

3.3 Individual attention and availability to my students

The attention that the instructor shows to his or her students plays a crucial role in the students' perceptions of the subject. Indeed, a caring instructor makes students feel more comfortable in class. As a result, they are more willing to ask questions and to participate in solving problems. Consequently, the student develops a positive attitude toward the whole course.

3.4 High standards in class behavior and high expectations

We all know that in order for the students to be good learners and high achievers, it is important to set high standards in the classroom. A lack of control over the classroom, for example, can lead to an unproductive learning environment for both good and poor students; good students are unable to focus because of the hectic environment, while poor students are unable to learn and improve their skills. From my experience in teaching preparatory courses, I have noticed that many students who fail the math placement test and require remedial math courses to improve their skills do not really see the need to take these courses and believe that they should have been placed in a higher level instead. They become frustrated, and this frustration leads to an unproductive learning environment. In this situation, the instructor must establish clear and firm rules for the classroom in order to provide students with a favorable atmosphere for better and more effective learning.

4. Conclusion

As we saw above, the major challenges facing a university math instructor are mostly related to how math is taught in high school, student dependency on the calculator, and student dependency on math tutoring.

To close this presentation and to finish with a positive side of the teaching, I would say that teaching math in general and teaching remedial courses in particular is quite rewarding and is an art in its own right. A good teacher is one who has the talent to motivate the students and to revive their curiosity. A good teacher is one who has the ability to develop in them the thirst and desire to learn, to succeed, and to go beyond their capabilities. A good teacher is one who knows how to help students to rebuild their self-confidence and how to face all challenges with patience and perseverance. A good teacher is one who likes the job and does it with great pleasure and enthusiasm. The student should never feel that the teacher considers the work to be a painful task with no value. Instead, the student must find in the teacher a valuable source of inspiration, and a good example of perseverance, patience, and motivation.

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